We claim:

Claim 1 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream;

b. preheating at least a portion of the first liquid stream and then sending the portion of the first liquid stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

c. cooling and partially condensing the tower overhead stream thereby producing a second vapor stream and a liquid hydrocarbon stream, the liquid hydrocarbon stream being sent to the distillation tower as a top feed;

d. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone as a bottom absorber feed streamthereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

e. preheating at least a portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream into the distillation tower as a middle tower feed stream;

f. cooling and condensing at least a portion of the second vapor stream thereby forming a first lean reflux stream and sending the first lean reflux stream to the absorber as an absorber top feed stream;

g. heating the absorber overhead stream, compressing, and discharging the absorber overhead stream as a residue gas stream; and

h. wherein the improvement comprises cooling and at least partially condensing the portion of the residue gas stream thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column.

Claim 2 The process according to Claim 1, wherein the improvement comprises sending the first lean reflux stream to the absorber column at a feed location below that of the second lean reflux stream.

Claim 3 The process according to Claim 1, wherein the improvement comprises combining the first and second lean reflux streams prior to sending the streams to the absorber column.

Claim 4 The process according to Claim 1, wherein the improvement comprises sending the second lean reflux stream to a top of the absorber column.

Claim 5 The process according to Claim 1, wherein the steps of cooling the gas stream, preheating at least a portion of the first liquid stream, preheating at least a portion of the absorber bottoms stream, heating the absorber overhead stream, and cooling a portion of the residue gas stream are performed by providing heat exchange contact with a process stream selected from the group consisting of the absorber overhead stream, the absorber bottoms stream, the first

liquid stream, the portion of the residue gas stream, the gas stream, an external refrigerant stream, and combinations thereof.

Claim 6 The process according to Claim 1, wherein the step of sending the portion of the first liquid stream to the distillation tower includes sending the portion of the first liquid stream as a lower tower feed stream.

Claim 7 The process according to Claim 1, wherein the steps of cooling and partially condensing the tower overhead stream include sending the liquid hydrocarbon stream to the distillation tower as a top tower feed stream.

Claim 8 The process according to Claim 1, wherein the step of sending the first vapor stream to the absorber column includes sending the first vapor stream as a bottom absorber feed stream.

Claim 9 The process according to Claim 1, wherein the step of sending the portion of the absorber bottoms stream to the distillation column includes sending the portion of the absorber bottoms stream as a middle tower feed stream.

Claim 10 The process according to Claim 1, wherein the steps of heating the absorber overhead stream, cooling a portion of the residue gas stream, cooling the tower overhead stream, and cooling at least a portion of the second vapor stream are performed by providing heat exchange contact with a process stream selected from the group consisting of the absorber overhead stream, the portion of the residue gas stream, the tower overhead stream, and the portion of the second vapor stream, and combinations thereof.

Claim 11 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane

and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. preheating at least a portion of the first liquid and then sending the portion of the first liquid stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

c. cooling and partially condensing the tower overhead stream thereby producing a second vapor stream and a liquid hydrocarbon stream;

d. sending the liquid hydrocarbon stream to the distillation tower;

e. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone as a bottom feed stream thereby producing an absorber overhead stream containing essentially all methane, C2, and lighter components of the gas stream and an absorber bottoms stream;

f. preheating at least a portion of the absorber bottoms stream and directing the portion of the absorber bottoms stream into the distillation tower;

g. condensing at least a portion of the second vapor stream thereby forming a first lean reflux stream and sending the first lean reflux stream to the absorber;

h. heating and compressing the absorber overhead stream to produce a residue gas stream; and

i. wherein the improvement comprises cooling and at least partially condensing a portion of the first vapor stream thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column.

Claim 12 The process according to Claim 11, wherein the improvement comprises sending the second lean reflux stream to a feed location located at least one mass transfer zone below that of the first lean reflux stream.

Claim 13 The process according to Claim 11, wherein the improvement comprises sending the first lean reflux stream to a top of the absorber column.

Claim 14 The process according to Claim 11, wherein the step of sending the portion of the first liquid stream to the distillation tower includes sending the portion of the first liquid stream to the distillation tower as a lower tower feed stream.

Claim 15 The process according to Claim 11, wherein the step of sending the liquid hydrocarbon stream to the distillation tower includes sending the liquid hydrocarbon stream to the distillatino tower as a top feed stream.

Claim 16 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone as a bottom feed stream thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

c. expanding at least the first liquid stream and feeding the first liquid stream to the absorber column 32;

d. preheating at least a portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream to a distillation tower [make this a dependent claim - as a bottom feed stream], the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

e. cooling and partially condensing the tower overhead stream thereby producing a second vapor stream and a liquid hydrocarbon stream, the liquid hydrocarbon stream being directed to the distillation tower as a top feed;

f. condensing at least a portion of second vapor stream thereby forming a first lean reflux stream and sending the first lean reflux stream to the absorber column;

g. heating the absorber overhead stream, compressing, and discharging the absorber overhead stream as residue gas; and

h. wherein the improvement comprises cooling and at least partially condensing the portion of the residue gas thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column. Make sending to top of the absorber a dependent claim.

Claim 17 The process according to Claim 16, wherein the improvement comprises sending the first lean reflux stream to a feed location below that of the second lean reflux stream.

Claim 18 The process according to Claim 16, wherein the improvement comprises sending the first lean reflux stream to a top of the absorber column.

Claim 19 The process according to Claim 16, wherein the step of feeding the first liquid stream to the absorber column 32 includes feed the first liquid stream to a feed location located below that of the expanded first vapor stream.

Claim 20 The process according to Claim 16, wherein the step of sending the portion of the absorber bottoms stream to a distillation tower includes sending the portion of the absorber bottoms stream to the distillation tower as a bottom feed stream.

Claim 21 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream;

b. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

c. expanding at least the first liquid stream and feeding the first liquid stream to the absorber;

d. preheating at least a portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

e. cooling and partially condensing the tower overhead stream thereby producing a second vapor stream and a liquid hydrocarbon stream;

f. sending the liquid hydrocarbon stream to the distillation tower[make this a dependent claim- as a top feed];

g. condensing at least a portion of the second vapor stream thereby forming a first lean reflux stream and sending the first lean reflux stream to the absorber column;

h. heating and compressing the absorber overhead stream to produce a residue gas stream; and

i. wherein an improvement comprises cooling and at least partially condensing a portion of the first vapor stream thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column.

Claim 22 The process according to Claim 21, wherein the improvement comprises sending the second lean reflux stream to a feed location located at least one mass transfer zone below that of the first lean reflux stream.

Claim 23 The process according to Claim 21, wherein the improvement comprises sending the second lean reflux stream to a top of the absorber column.

Claim 24 The process according to Claim 21, wherein the step of sending the first vapor stream to an absorber column includes sending the first vapor stream as a bottom feed stream.

Claim 25 The process according to Claim 21, wherein the step of sending the liquid hydrocarbon stream to the distillation tower includes sending the liquid hydrocarbon stream to the distillation column as a top tower feed stream.

Claim 26 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. preheating at least a portion of the first liquid and then sending the portion of the first liquid into a distillation tower as a lower tower feed stream, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

c. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

d. sending at least a portion of the tower overhead stream to the absorber column as a first lean reflux stream;

e. heating and compressing the absorber overhead stream to produce a residue gas stream; and

f. wherein an improvement comprises preheating a first portion of the absorber bottoms stream and sending the first portion of the absorber bottoms stream to the distillation tower, and sending a second portion of the absorber bottoms stream to the distillation tower.

Claim 27 The process according to Claim 26, wherein the improvement further comprises sending the first portion of the absorber bottoms stream to a lower feed location that that of the second portion of the absorber bottoms stream.

Claim 28 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

c. expanding at least the first liquid stream and feeding the first liquid stream to the absorber column[, below expanded first vapor stream feed location – make this a dependent claim];

d. preheating at least a portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

e. condensing at least a portion of a tower overhead stream and sending it to the absorber column as a first lean reflux stream;

f. heating the absorber overhead stream, compressing, and discharging the absorber overhead stream as a residue gas; and

g. wherein an improvement comprises preheating a first portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream to the distillation tower, and sending a second portion of the absorber bottoms stream to the distillation tower.

Claim 29 The process according to Claim 28, wherein the improvement further comprises sending the first portion of the absorber bottoms stream at a lower feed location than that of the second portion of the absorber bottoms stream.

Claim 30 The process according to Claim 28, wherein the step of feeding the first liquid stream to the absorber column includes feeding the first liquid stream at a feed location located below that of the expanded first vapor stream.

Claim 31 The process according to Claim 28, wherein the improvement further comprises cooling and at least partially condensing a portion of the residue gas stream thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column.

Claim 32 The process according to Claim 31, wherein the first lean reflux stream is introduced at a feed location located below that of the second lean reflux stream.

Claim 33 The process according to Claim 31, wherein the second lean reflux stream is sent to a top of the absorber column.

Claim 34 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. expanding the first vapor stream and sending the first vapor stream to an absorber column having at least one mass transfer zone thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and an absorber bottoms stream;

c. expanding at least the first liquid stream and feeding the first liquid stream to the absorber column;

d. preheating at least a portion of the absorber bottoms stream and sending the portion of the absorber bottoms stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

e. condensing at least a portion of the tower overhead stream and sending it to the absorber column as a first lean reflux stream;

f. heating and compressing the absorber overhead stream to produce a residue gas stream; and

g. wherein an improvement comprises cooling and at least partially condensing a portion of the first vapor stream thereby producing a second lean reflux stream and then sending the second lean reflux stream to the absorber column.

Claim 35 The process according to Claim 34, wherein the second lean reflux stream is sent to the absorber column at a feed location located at least one mass transfer zone below that of the first lean reflux stream.

Claim 36 The process according to Claim 34, wherein the step of feeding the first liquid stream to the absorber column includes feeding the first liquid stream to a feed location located below that of the expanded first vapor stream.

Claim 37 The process according to Claim 34, wherein the second lean reflux stream is sent to a top of the absorber column.

Claim 38 A process for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane components and a less volatile fraction containing a large portion of C2 components and heavier hydrocarbons, the process comprising the steps of:

a. supplying and cooling a gas stream to partially condense at least a portion of the gas stream to produce a first vapor stream and at least a first liquid stream containing some lighter components;

b. sending the first liquid stream to a distillation tower, the distillation tower producing a tower overhead stream containing mainly methane components and a tower bottoms stream containing a majority of the C2 components and heavier hydrocarbons;

c. splitting the first vapor stream into a first separator overhead stream and a second overhead stream;

d. expanding and sending the first separator overhead stream to an absorber column having at least one mass transfer zone thereby producing an absorber overhead stream containing essentially all methane and lighter components of the gas stream and an absorber bottoms stream;

e. cooling the second separator overhead stream and sending the second separator overhead stream to the absorber column;

f. heating and compressing the absorber overhead stream to produce a residue gas stream; and

g. wherein an improvement comprises condensing at least a portion of the tower overhead stream thereby producing a first lean reflux stream and sending the first lean reflux stream to the absorber.

Claim 39 The process according to Claim 38, wherein the improvement further includes sending the first lean reflux stream to the absorber to a feed location located below at least the first mass transfer zone.

Claim 40 The process according to Claim 38, wherein the step of cooling the gas stream includes cooling at least a portion of the gas stream by heat exchange contact with at least one tower side stream thereby heating the at least one tower side stream prior to being sent back to the distillation column.

Claim 41 An apparatus for separating a gas stream containing methane, C2 and C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all of the methane and C2 components and a less volatile fraction containing a large portion of C3 components and heavier hydrocarbons, the apparatus comprising:

a. a first exchanger for performing a process step selected from the group consisting of cooling a gas stream to partially condense at least a portion of the gas stream, preheating at least a portion of a first liquid stream, preheating at least a portion of an absorber bottoms stream, heating the absorber overhead stream, cooling and at least partially condensing the portion of the residue gas stream thereby producing a second lean reflux stream, and combinations thereof;

b. a first separator for separating the gas stream into a first vapor stream and at least the first liquid stream;

c. a distillation tower for receiving the portion of the first liquid stream as a lower tower feed stream and for receiving a portion of an absorber bottoms stream as a middle tower feed stream, the distillation tower producing a tower overhead stream containing mainly methane and C2 components and a tower bottoms stream containing a majority of the C3 components and heavier hydrocarbons;

d. a second exchanger for performing a process step selected from the group consisting of cooling the tower overhead stream thereby producing a second vapor stream and a liquid hydrocarbon stream, cooling and condensing at least a portion of the second vapor stream thereby forming a first lean reflux stream, heating the absorber overhead stream, cooling and at least partially condensing the portion of the residue gas stream thereby producing a second lean reflux stream

e. an expander for expanding the first vapor stream;

f. an absorber column having at least one mass transfer zone for receiving the first vapor stream as a bottom absorber feed streamthe first lean reflux stream as an absorber top feed stream, and the second lean reflux stream, the absorber column thereby producing an absorber overhead stream containing essentially all methane, C2 and lighter components of the gas stream and the absorber bottoms stream; and

g. a compressor for compressing the absorber overhead stream to produce a residue gas stream.

Claim 42 The apparatus of Claim 41, including a second separator for separating the tower overhead stream into a second vapor stream and a liquid hydrocarbon stream.

Claim 43 The apparatus of Claim 41, wherein the absorber comprises at least one mass transfer zone.

Claim 44 The apparatus of Claim 41, wherein the absorber comprises more than one mass transfer zone.

Claim 45 The apparatus of Claim 41, further comprising a third exchanger for performing a process step selected from the group consisting of cooling at least a portion of the gas stream, warming at least one tower reboiler side stream, and combinations thereof.